AD-774 267

EFFECTS OF HELICOPTER EXTERNAL LOADS ON SLING PROPERTIES

Arthur J. Gustafson, Jr., et al

Army Air Mobility Research and Development Laboratory
Fort Eustis, Virginia

September 1973

AD 774 267

Unclassified
Security Classification

AD774267

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)
Eustis Directorate
U.S. Army Air Mobility Research and Development Laboratory, Fort Eustis, Virginia

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE
EFFECTS OF HELICOPTER EXTERNAL LOADS ON SLING PROPERTIES

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Final Report

5. AUTHOR(S) (First name, middle initial, last name)
Arthur J. Gustafson, Jr.
Max E. Bryan
Edgar H. McIlwean
Eugene A. Birocco

6. REPORT DATE
September 1973

7a. TOTAL NO. OF PAGES
88

7b. NO. OF REFS
6

8a. CONTRACT OR GRANT NO.

b. PROJECT NO.

c. Task 1F162203A43500
House Task AS70-11

d.

9a. ORIGINATOR'S REPORT NUMBER(S)
USAAMRDL Technical Report 73-91

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10. DISTRIBUTION STATEMENT
Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY
Eustis Directorate
U.S. Army Air Mobility R&D Laboratory
Fort Eustis, Virginia

13. ABSTRACT
Samples of webbing of the type currently used for slings to carry external cargo by Army helicopters were tested to determine which environmental factors contributed to premature failure of the webbing. The environmental factors included outdoor exposure, temperature, humidity, JP-4 and seawater immersion, sand, and vibratory loading. Several types of nylon and Dacron were tested.

The results of these tests indicate that outdoor exposure has a major effect on webbing strength. The presence of sand between the yarns in the webbing produces early failure. Shackle FSN 1670-090-5354 causes severe damage to slings under vibratory loading if used without a protective pad. Temperature, humidity, fuel and seawater immersion, and indoor storage have a negligible effect on webbing strength.

DD FORM 1 NOV 65 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

Unclassified
Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Sling properties						
Nylon and Dacron webbing						
Helicopter external loads						
Sling strength						

iv

Task 1F162203A43500
House Task AS70-11
USAAMRDL Technical Report 73-91
September 1973

EFFECTS OF HELICOPTER EXTERNAL LOADS ON SLING PROPERTIES

Final Report

By

Arthur J. Gustafson, Jr.
Max E. Bryan
Edgar H. McIlwean
Eugene A. Birocco

EUSTIS DIRECTORATE
U.S. ARMY AIR MOBILITY RESEARCH AND DEVELOPMENT LABORATORY
FORT EUSTIS, VIRGINIA

TABLE OF CONTENTS

Preceding page blank

LIST OF ILLUSTRATIONS

LIST OF TABLES

INTRODUCTION

Slings and cargo nets are widely used to carry external loads on helicopters. Slings are light, flexible structures, well suited to this task. However, a current lack of acceptable criteria for the design and rating of slings and nets seriously inhibits their use. Insufficient knowledge of the external helicopter environment and of the dynamic loads developed is an area of particular concern. The result has been rigging difficulties and short usable life compared to aircraft capability.

Although the Army, as well as the other services, has performed a number of studies on slings, the broad range of problems associated with the Army's use of slings has not been simultaneously considered. The effort described in this report and the work done under contract with the Sikorsky Aircraft Division, United Aircraft Corporation, to establish design criteria for typical sling configurations[1] and to produce a comprehensive design guide for helicopter slings[2] were undertaken to reduce current deficiencies.

TEST METHODS

A complex series of tests was conducted to provide a complete characterization of the webbing materials within the limitation of the laboratory equipment. The tests were set up to the extent possible to isolate the various parameters. Table I lists the number of tests conducted, sample sizes, and types of materials tested. Detailed descriptions of the tests follow.

Each type of webbing was tested for tensile ultimate strength in the "as-received" condition. This test became the standard for determining the effects of environmental factors or type of loading. The mean and standard deviation of the ultimate strength were calculated from the results of the standard tests and from the results of tests conducted on webbing that had been exposed to one of the environments listed in Table I. The two groups of data were compared by using a statistical technique (student's t distribution) that tests the hypothesis that two samples come from the same population. This test is used for small sample sizes ($N < 30$) and is equivalent to the more familiar "Z" parameter test used for large samples.

TABLE I. LIST OF TESTS

	Sample Size					
	Nylon, Type X	Nylon, Type XIX	Nylon, Type XXVI-R	Nylon, Type XXVI-L	Dacron, Type VI	Dacron, Type V
Baseline Test						
Ultimate Strength	15	15	15	28	15	16
Environmental Test						
Outdoor Exposure	12	12	10	12	12	10
Temperature/Humidity Cycling	10	10	9	7	10	10
JP-4 Fuel Immersion	5	5	5	5	4	5
Seawater Immersion	4	5	5	5	5	4
Sand Exposure	10	27	10	10	10	14
End-Condition Effect	7	11	10	12	12	13
Viscoelastic Properties	18	18	18	18	18	18
Indoor Storage	5	5	5	5	5	5

ULTIMATE STRENGTH (BASELINE) TESTS

Ultimate strength tests were conducted on 5-foot-long webbing specimens that were fitted with nylon webbing doublers on each end (Figure 1). The specimens were mounted in the test fixture as shown in Figure 2. The sequence of loading the specimens is shown in Figure 3. The preload on each specimen was necessary because the 5-inch stroke limitation of the test machine (MTS Model 483.01) is less than the ultimate extension of the specimens.

Figure 1. Test Specimen Showing Doublers in Section That Fits in the Grips.

Figure 2. Test Specimen Mounted in Test Fixture.

NOTE

GAGE LENGTH IS 15 IN. (LENGTH OUT OF GRIPS).
LOADING FROM 0–A WITH CROSSHEAD MOVEMENT,
FROM A–B WITH RAM, FROM C–D WITH CROSSHEAD,
FROM D–F WITH RAM.
LOADING RATES IN EACH SEGMENT WERE:

0–A & C–D	250 LB/SEC
A–B	5000 LB/SEC
D–F	7000 LB/SEC

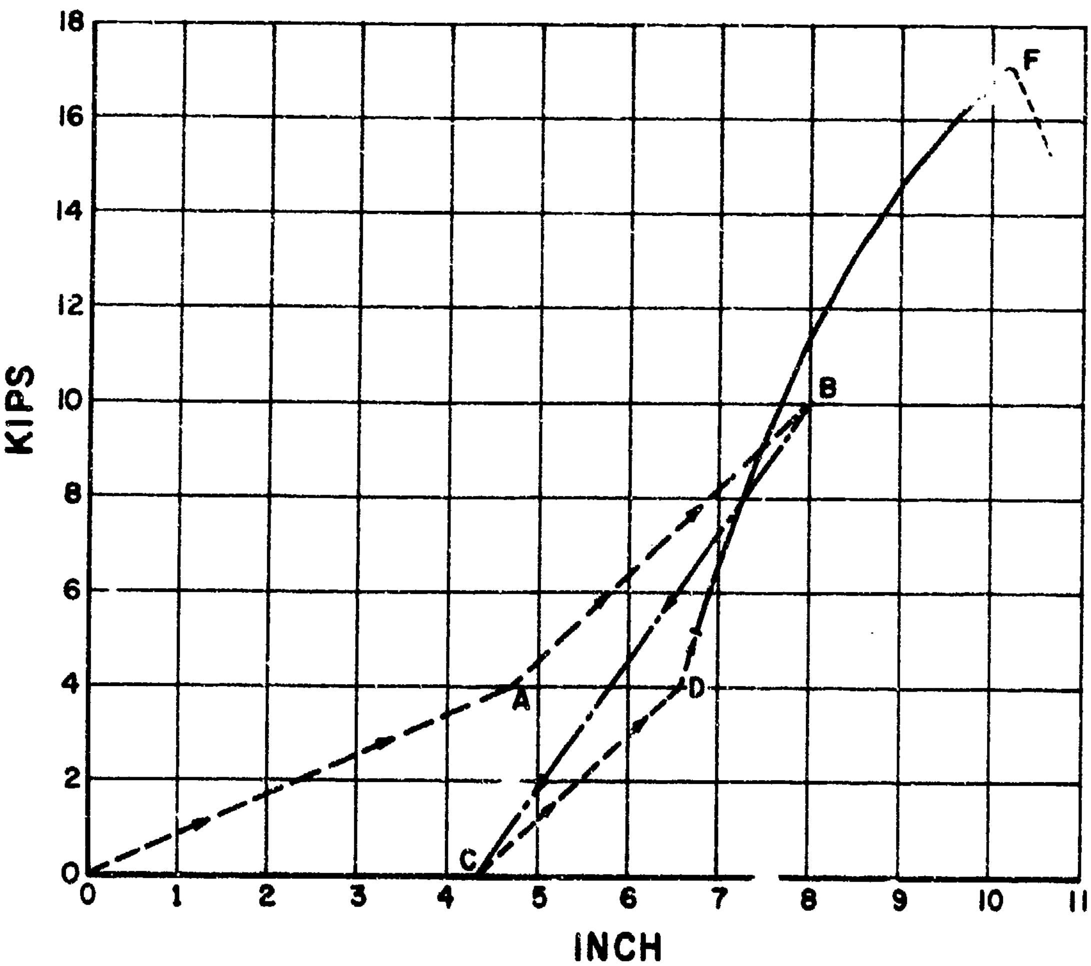

Figure 3. Sequence of Loading for Ultimate Strength Teot.

OUTDOOR EXPOSURE TESTS

Three groups (nominally five specimens each) of 5-foot-long webbing specimens were exposed outdoors for 16 weeks, 32 weeks, and 40 weeks, respectively. Each group was tested for ultimate strength after exposure. Mean temperature, rainfall, and cloud cover during the test periods are given in Table II.

TABLE II. MEAN TEMPERATURE, RAINFALL, AND CLOUD COVER FOR THE PERIOD APRIL 1970 THROUGH MARCH 1971

Date	Temperature (°F) Max	Temperature (°F) Min	Rain (in.) Max	Cloud Cover (Tenths)	Mean Temperature (°F) Max	Mean Temperature (°F) Min
April 1970	86	38	3.39	6.4	67	48
May	89	41	4.76	6.2	76	57
June	96	55	3.65	6.2	83	65
July	92	64	7.82	6.3	85	71
August	94	60	1.86	6.4	84	67
September	93	49	3.82	5.6	79	61
October	83	37	1.32	4.7	69	51
November	72	25	3.53	5.4	61	43
December	70	25	3.25	5.8	49	32
January 1971	67	19	2.82	5.8	47	30
February	72	19	4.31	6.2	48	32
March	76	31	3.12	6.0	59	40

Temperature and Rainfall - actual values for 1970-1971
Cloud cover - mean value in tenths for years 1961-1970, between 0600-1800 LST
Mean temperature - average for years 1961-1970

TEMPERATURE/HUMIDITY EXPOSURE

Ten 5-foot-long webbing specimens for each type of webbing were exposed to the temperature/humidity test (less altitude simulation), as described in MIL-STD-810B. The temperature/humidity ranges for this test are presented in Table III.

TABLE III. TEMPERATURE/HUMIDITY CYCLE

Day	Time (hr)	Temperature (°F)	Relative Humidity (%)
1 through 5	0800-1600	-65	-
	1600-0800	+160	95
6 and 7	0800-1600	+160	95
	1600-0800	+160	95
8 through 11	0800-1600	-65	-
	1600-0800	+160	95
12	0800-1600	-65	-
	1600-0800	-80	-
13 and 14	0800-1600	-80	-
	1600-0800	-80	-

JP-4 FUEL IMMERSION TESTS

The 5-foot-long webbing specimens were immersed in JP-4 fuel (MIL-T-5624) for 24 hours and then tested for ultimate strength.

SEAWATER IMMERSION TESTS

The 5-foot-long webbing specimens were immersed in seawater for 24 hours and then tested for ultimate strength. Tests were performed with the webbing both wet and dry.

SAND ABRASION TESTS

Six types of webbing were tested for effects of imbedded sand. The specimens for Type XIX webbing were divided into four groups. One group was tested untreated to serve as a baseline. The other three groups were treated with different sizes of sand: fine, medium, and coarse, respectively. The remaining webbing types were divided into two groups: untreated and treated with medium-grit sand only.

The specimens were 5 feet long, with doublers on each end, as shown in Figure 1. A 1-inch section of the webbing was imbedded with sand by rubbing the sand in with the fingers while flexing the webbing to assure penetration of the sand between strands.

The webbing was studied with high-speed photography during testing and was visually inspected after testing.

END-CONDITION-EFFECTS TESTS

Reference 3 reports the effects on webbing strength of looping webbing over pins of various diameters and pulling in tension to failure. These tests were similar except that a service shackle was used, and the loading consisted of mean and alternating loads instead of pure tension. The alternating loads were representative of typical rotor-induced vibrating loads.

Tests were made to determine the effect of mean and alternating loads on webbing looped once over a 1-inch shackle (FSN 1670-090-5354); see Figure 4. The test specimens were 6 feet long and were prepared in the same manner as the 5-foot-long specimen shown in Figure 1.

The mean and alternating loads and the frequency of the alternating loads were taken from Reference 4 and represent a loading condition found in service use, which is also within the frequency and stroke limitation of the test machine.

Each specimen was tested to failure or 10,000 cycles, whichever occurred first. Specimens that did not fail were tested in tension to determine residual ultimate strength.

VISCOELASTIC TESTS

A 100,000-pound-capacity closed-loop hydraulic test machine was used to perform the dynamic tests. Loads and elongation were recorded using a strip-chart recorder and an X-Y plotter. The loads were detected with a load cell mounted above the upper teardrop-type grip, and unit elongation was measured with an extensometer mounted on the specimen with a gage length of approximately 1-3/16 inches. Each specimen was loaded to six different predetermined loads and cycled ± 10 percent of these values at rates of 3 hertz, 6 hertz, and 9 hertz for 100 cycles at each rate. Also, each specimen was loaded to 4,000 pounds prior to testing to obtain an initial stretching of the webbing.

The data recorded were gage length, mean load, alternating load, and alternating elongation. Using these data, the alternating strain and the spring constants were calculated at each load rate. Each specimen was tested by application of a mean load with an alternating load superimposed.

A major problem in conducting the viscoelastic tests was obtaining good decoupling of the test machine from the test specimen; that is, preventing

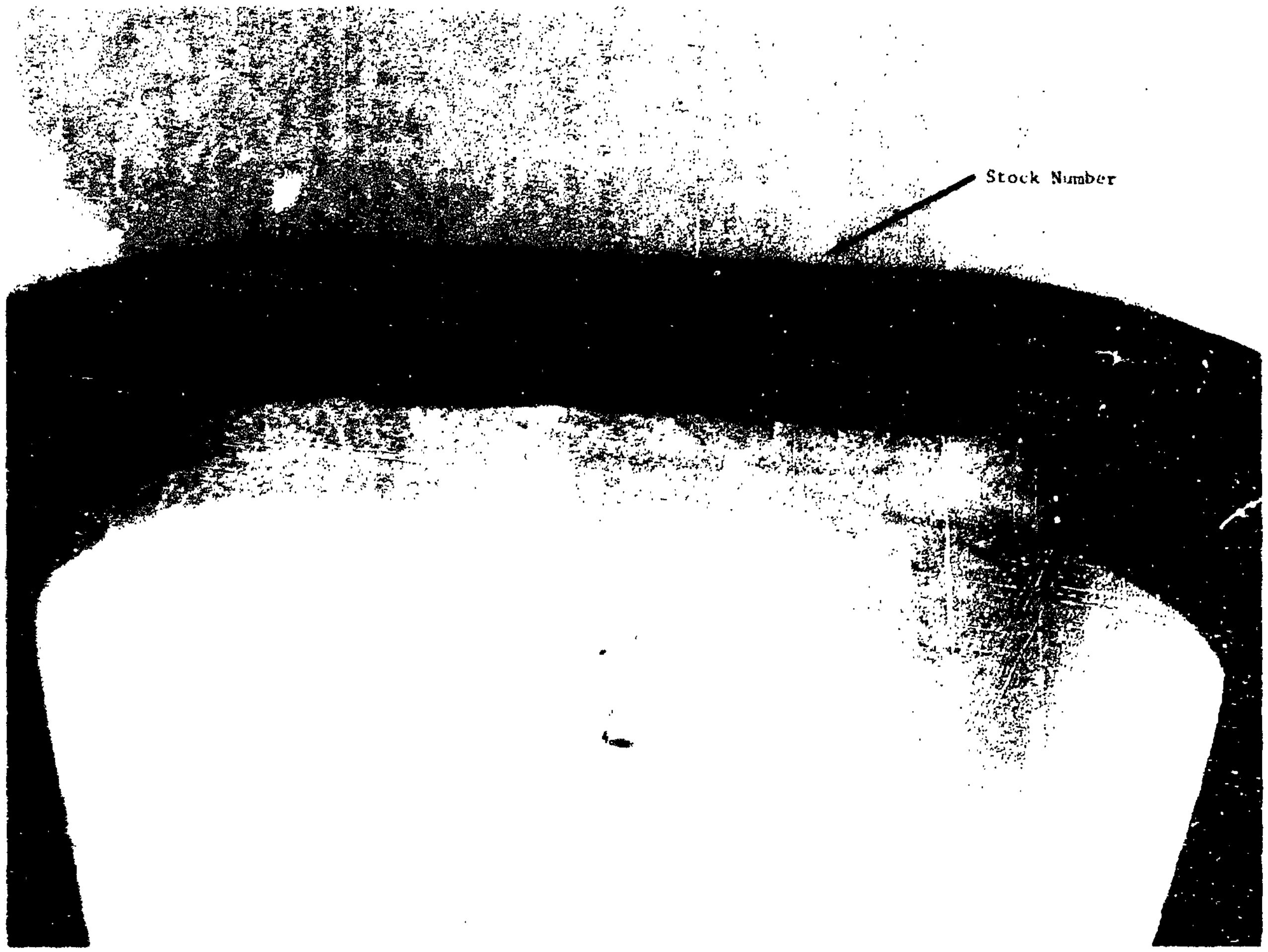

Figure 4. Close-up of Shackle FSN 1670-090-5354 Showing Surface Features Which Cause Damage to Webbing.

the specimen and test machine from acting as a spring-mass system. This was done in this test by the feedback control feature of the hydraulic test machine. Alternating load and frequency of oscillation were controlled by feedback loops, and the machine hydraulic flow capacity for effective control was not exceeded. The spring rates measured are considered to be accurate.

Spring rates may also be calculated by using the force-deflection data from the ultimate load tests. These data yield inaccurate spring rates for the following reasons:

- No effort was made to minimize machine-specimen interaction, and the hydraulic flow rate was outside the limits for effective control.

- Exact lengths of the specimens were unknown due to stretching of the webbing in the grips.

- There was a tracking error of the pen recorder.

INDOOR STORAGE TESTS

The effect of indoor storage was measured by comparing the ultimate strength of untreated specimens tested at the beginning of this program and similar specimens tested 1 year later.

TEST RESULTS

A complete set of test data, as well as the detailed results of the test, is given in the appendix. A qualitative summary of the effects of environmental conditions is given in Table IV, and a summary of test results is given in Table V.

TABLE IV. SUMMARY OF EFFECTS OF ENVIRONMENTAL CONDITIONS

Environment	DOES ENVIRONMENT AFFECT STRENGTH? Nylon, Type X	Nylon, Type XIV	Nylon, Type XXVI-R	Nylon, Type XXVI-L	Dacron, Type VI	Dacron, Type V
Outdoor Exposure	Yes	Yes	Yes	Yes	Yes	Yes
Temperature/Humidity Exposure	No	No	No	No	No	No
Seawater Immersion	Slightly	Slightly	Slightly	Slightly	Slightly	Slightly
JP-4 Fuel Immersion	Slightly	No	No	No	No	No
End-Condition Effects	Yes	Yes	Yes	Yes	Yes	Yes
Sand Exposure	Yes	Yes	Yes	Yes	Yes	Yes
Indoor Storage	Slightly	No	Slightly	Slightly	No	No

TABLE V. SUMMARY OF TEST RESULTS

Test	Nylon, Type X	Nylon, Type XIX	Nylon, Type XXVI-R	Nylon, Type XXVI-L	Dacron, Type V	Dacron, Type VI
	MEAN BREAKING STRENGTH*, KSI WEBBING TYPE					
New Material	10.80	11.95	17.26	16.85	12.30	20.21
Outdoor Exposure (32 weeks)	9.82	9.65	15.03	9.37	10.03	17.63
Temperature/Humidity	10.38	12.07	17.18	16.89	12.50	19.54
Seawater Immersion	9.38	10.98	16.03	16.82	12.80	19.54
JP-4 Fuel Immersion	10.50	12.64	16.68	17.24	12.58	20.25
Ultimate Strength After Fatigue Over 1-In. Shackle						
Low Mean Load	9.80	11.28	16.88	16.27	11.90	21.10
Medium Mean Load	9.60	11.05	16.10	15.63	11.52	20.16
High Mean Load	7.20	8.20	12.10	11.75	8.30	17.42
Indoor Storage (1 yr)	10	11.26	16.58	16.79	12.38	19.02
Sand Abrasion (no sand)**	2,710	3,789	1,099	1,039	1,634	2,753
Sand Abrasion (with sand)	7	19	5	7	2	3

* See appendix.
** Cycles to failure.

OUTDOOR EXPOSURE, TEMPERATURE/HUMIDITY CYCLING TESTS

The test results (appendix) show that outdoor exposure had a substantial effect on webbing strength, whereas gross temperature/humidity cycling had no effect on webbing strength. A major difference in the two exposures is the presence of sunlight in the outdoor test. It is known that ultraviolet radiation severely degrades the strength of nylon,[5] and this appears to be the cause for the strength reduction associated with outdoor exposure.

JP-4 AND SEAWATER IMMERSION TESTS

Seawater immersion had a slight effect on webbing strength. JP-4 fuel immersion had no effect on webbing strength.

SAND ABRASION TESTS

The effect of sand embedded in webbing greatly reduces the strength of the webbing. An examination of partially failed slings and the failure modes revealed significant damage to the fibrils and strands due to the sand.

High-speed photographs taken during testing and a visual inspection made after testing clearly show that fibrils and yarns of the webbing are cut in a transverse direction by the sand particles from the scissor motion of the yarns upon application of the load. Abrasive action of the sand between adjacent yarns does not develop because there is very little relative motion between yarns in the longitudinal direction.

The statistical analysis of test data does not show the significance of the sand treatment because the standard deviation of the baseline sample is quite large. This large variability of the baseline test results was brought about by failure of the test specimens in the grips, whereas all specimens with sand failed in the 1-inch strip that contained the sand. It is concluded that the wide variation in strength of the baseline sample is due to grip effects and invalidates the statistical test.

END-CONDITION-EFFECTS TESTS

End conditions have considerable effect on webbing strength. It was discovered that the mold parting line and the embossed stock number on the shackle used for this test caused damage sufficient to initiate failure of the webbing (see Figure 5 for example). It was characteristic that the failure time from the first strand cut to complete separation of the webbing was shortest with increased mean load. Although some types of webbing performed better than others in this test, it was clear that protective measures must be used with end fittings to a type similar to shackle FSN 1670-090-5354.

Figure 5. View of Webbing Which Was Damaged by Shackle FSN 1670-090-5354.

VISCOELASTIC TESTS

The results of the viscoelastic tests for the various types of webbing are plotted in the appendix.

INDOOR STORAGE TESTS

Test results show that indoor storage has a negligible effect on webbing strength.

CONCLUSIONS

It is concluded that:

1. Outdoor exposure of slings made with nylon and Dacron webbing is a major cause of reduction in sling strength.

2. The presence of sand, either coarse or fine, between yarns in slings made with nylon and Dacron webbing will cause failure upon application of both steady and vibratory loads.

3. Shackle FSN 1670-090-5354 causes severe damage to slings made with nylon and Dacron webbing under vibratory loading, if used without a protective pad.

4. Seawater, JP-4 fuel, temperature/humidity cycling, and indoor storage have negligible effects on the strength of slings made with nylon and Dacron webbing.

RECOMMENDATIONS

It is recommended that:

1. Provisions be incorporated into the design of slings made with nylon and Dacron webbing for protection against sunlight and sand.

2. Slings made with nylon and Dacron webbing used with shackle FSN 1670-090-5354 (or equivalent) be protected with a pad, as shown in Reference 6.

3. Shackle FSN 1670-090-5354 be redesigned to have a smooth bearing surface.

LITERATURE CITED

1. Briczinski, S. J., and Karas, G. K., CRITERIA FOR EXTERNALLY SUSPENDED HELICOPTER LOADS, Sikorsky Aircraft Division of United Aircraft Corporation; USAAMRDL Technical Report 71-61, Eustis Directorate, U. S. Army Air Mobility Research and Development Laboratory, Fort Eustis, Virginia, November 1971, AD 740772.

2. Huebner, W. E., DESIGN GUIDE FOR LOAD SUSPENSION POINTS, SLINGS, AND AIRCRAFT HARD POINTS, Sikorsky Aircraft Division of United Aircraft Corporation; USAAMRDL Technical Report 72-36, Eustis Directorate, U. S. Army Air Mobility Research and Development Laboratory, Fort Eustis, Virginia, July 1972, AD 747814.

3. Maroney, Josef P., WEBBING-HARDWARE COMBINATION STUDY FOR THE AIRDROP ENGINEERING DIVISION, AMSRE-NIEL 810, U. S. Army Natick Laboratories, Natick, Massachusetts, July 1966.

4. Wilson, G., and Midgett, J., VERIFICATION FLIGHT TEST RESULTS OF THE PHASE III CH-47A HELICOPTER SLING LOAD CAPABILITY INVESTIGATION AND SLING LOAD MANUAL, Report No. 114-DV-008 (AF33(657) 1315/SRD14), The Boeing Company, Vertol Division, Morton, Pennsylvania, 1967.

5. Wilkinson, Robert A., THE EFFECT OF SOLAR RADIATION ON THE BREAKING STRENGTH OF OUTDOOR EXPOSED WEBBING, Materials Laboratory, Wright Air Development Center, WADC Technical Report 58-201, Wright-Patterson Air Force Base, Ohio, November 1958, AD 206893.

6. Department of the Army, AIR TRANSPORT OF SUPPLIES AND EQUIPMENT: HELICOPTER EXTERNAL LOADS RIGGED WITH AIR DELIVERY EQUIPMENT, Technical Manual 55-450-11, pp. 6 and 8 (Figure 3), July 1966.

APPENDIX

TEST RESULTS

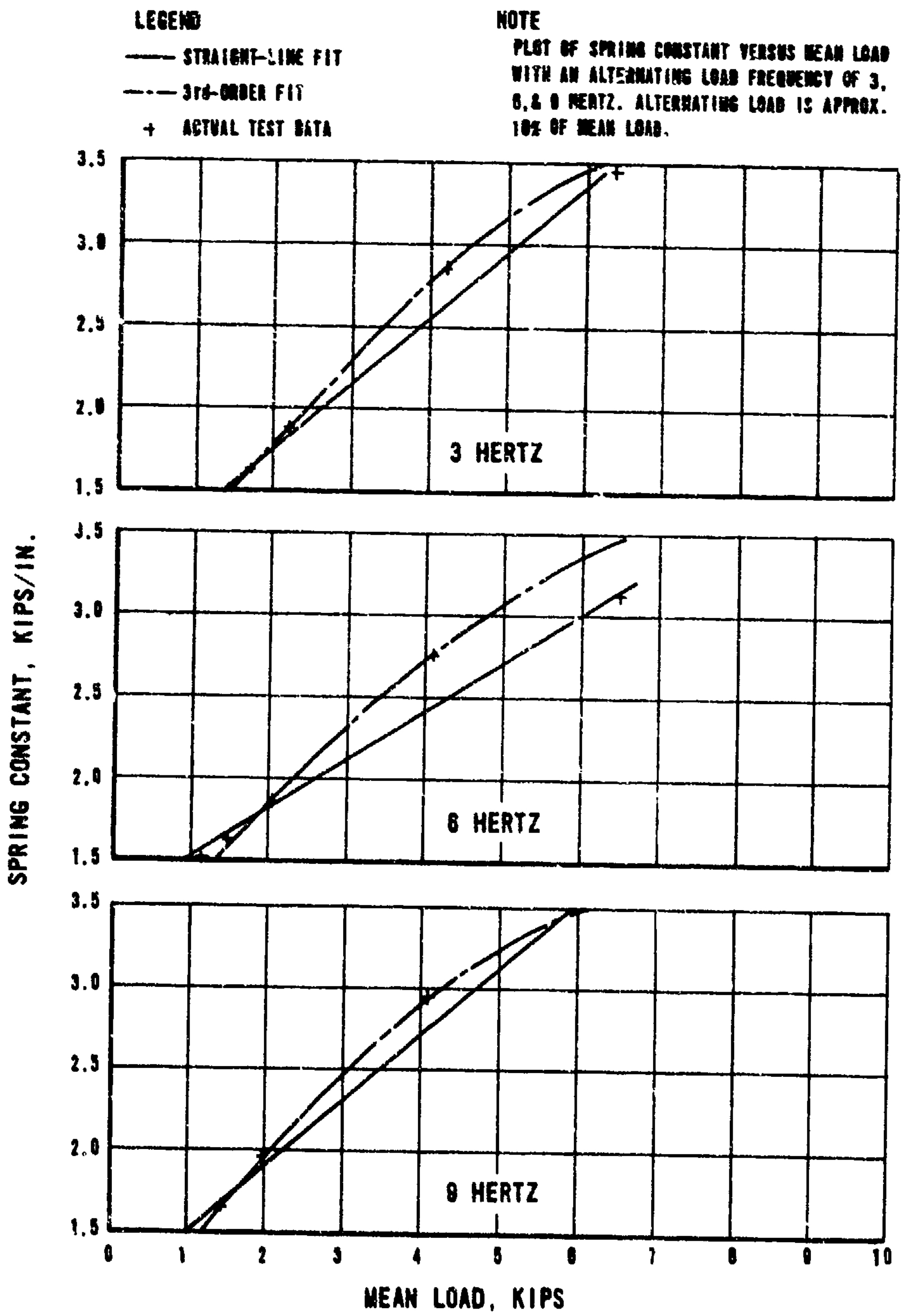

Figure 6. Plot of Viscoelastic Data, Type X Nylon Webbing.

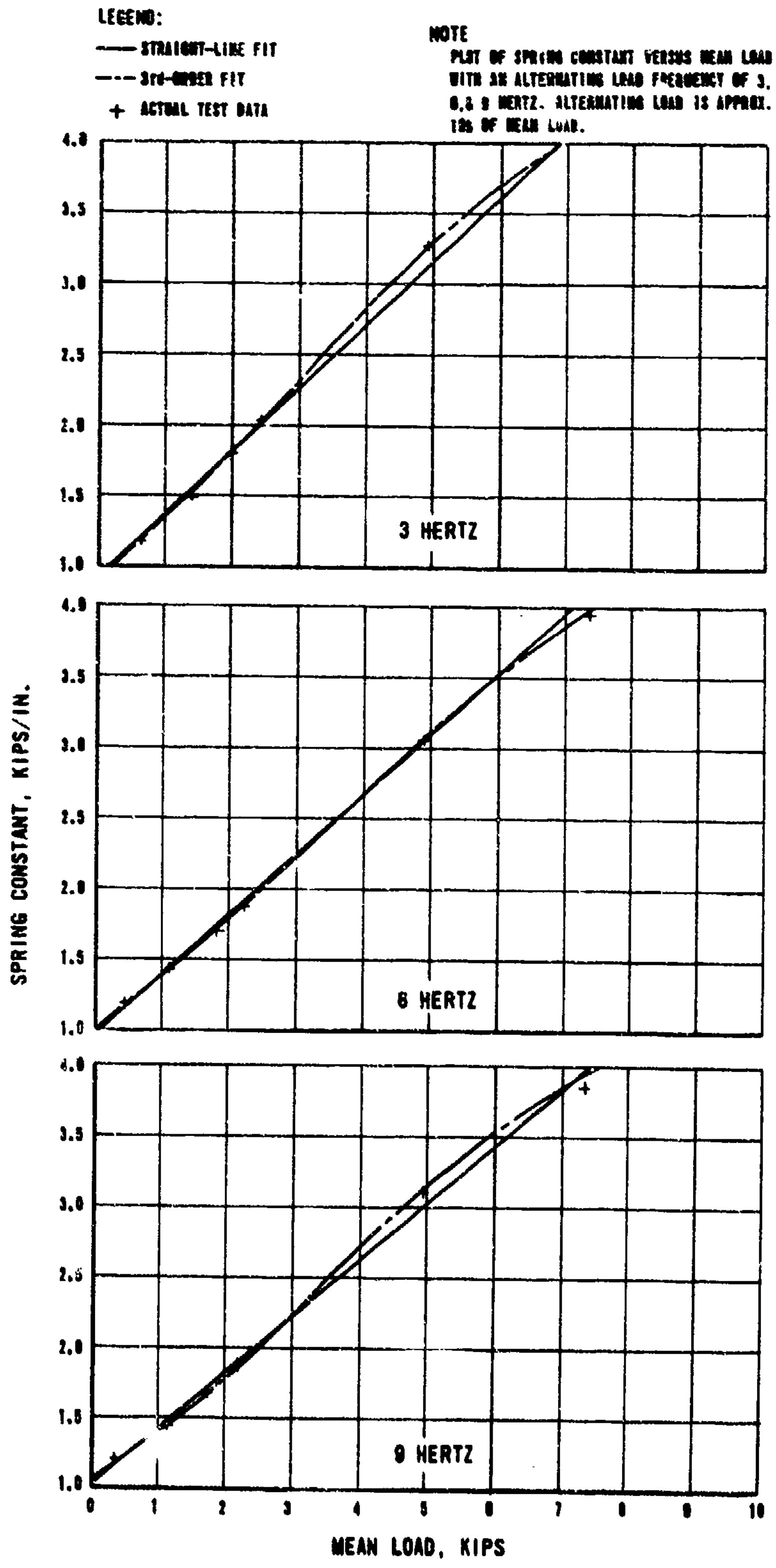

Figure 7. Plot of Viscoelastic Data, Type XIX Nylon Webbing.

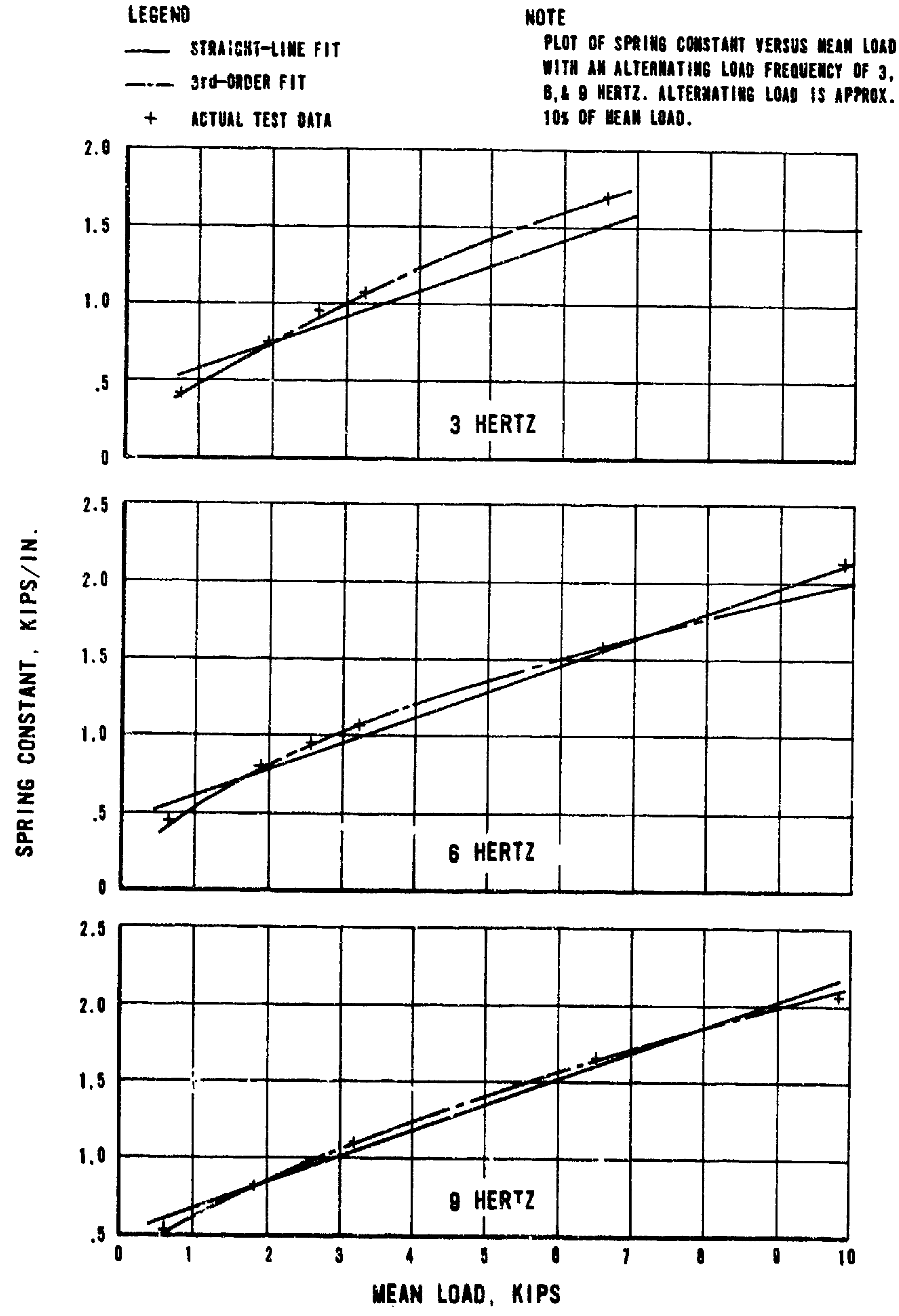

Figure 8. Plot of Viscoelastic Data, Type XXVI-R Nylon Webbing.

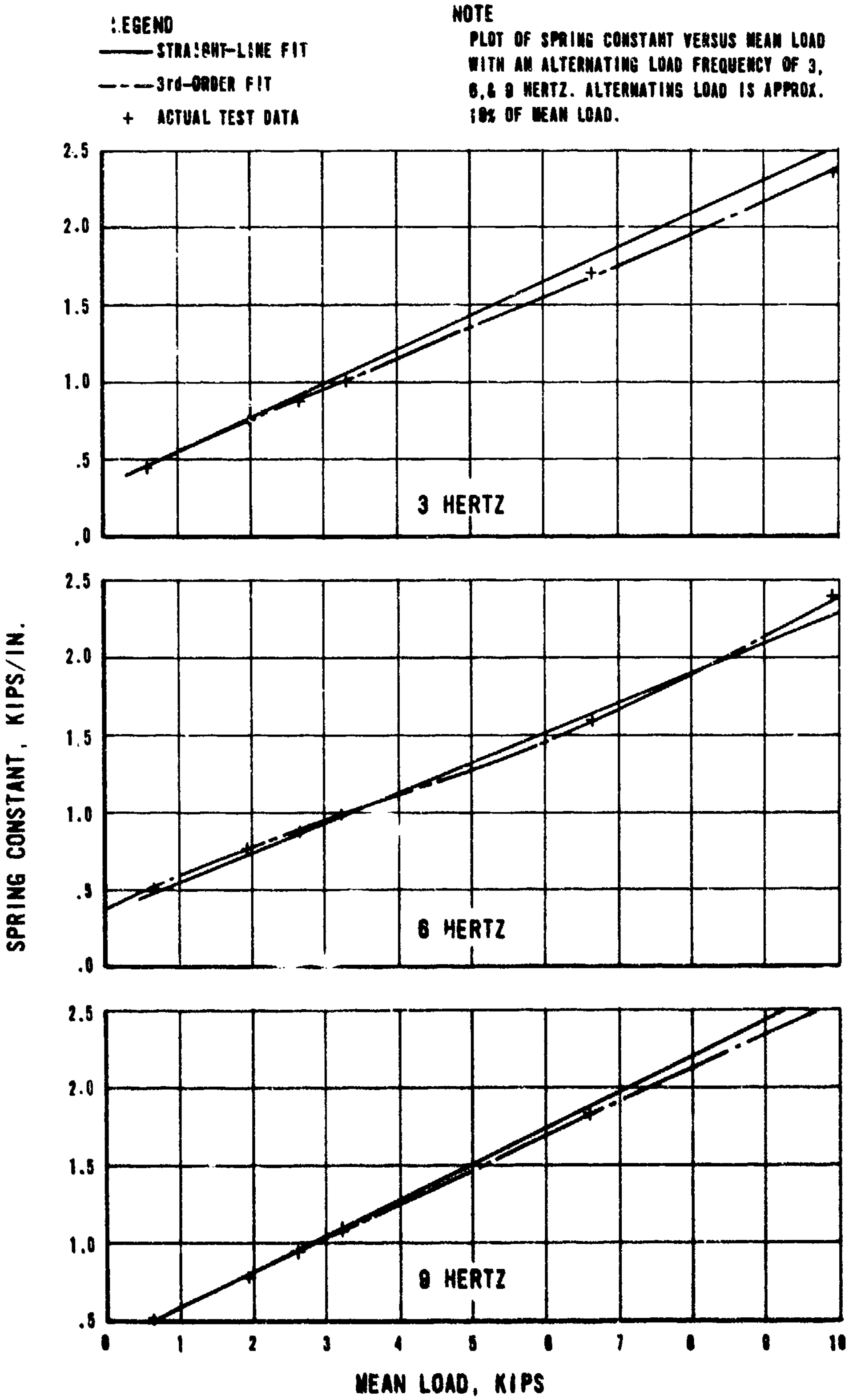

Figure 9. Plot of Viscoelastic Data, Type XXVI-L Nylon Webbing.

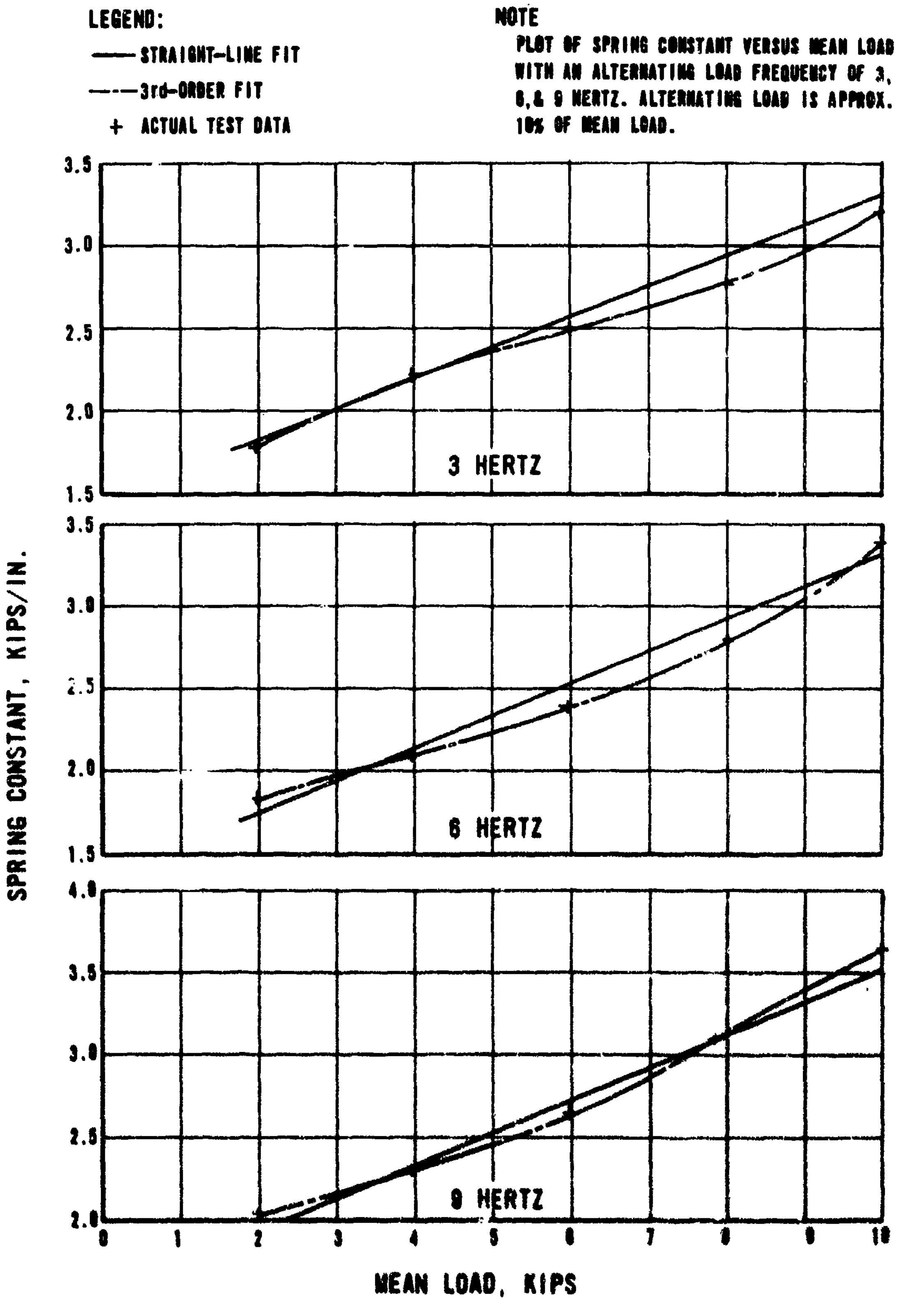

Figure 10. Plot of Viscoelastic Data, Type VI Dacron Webbing.

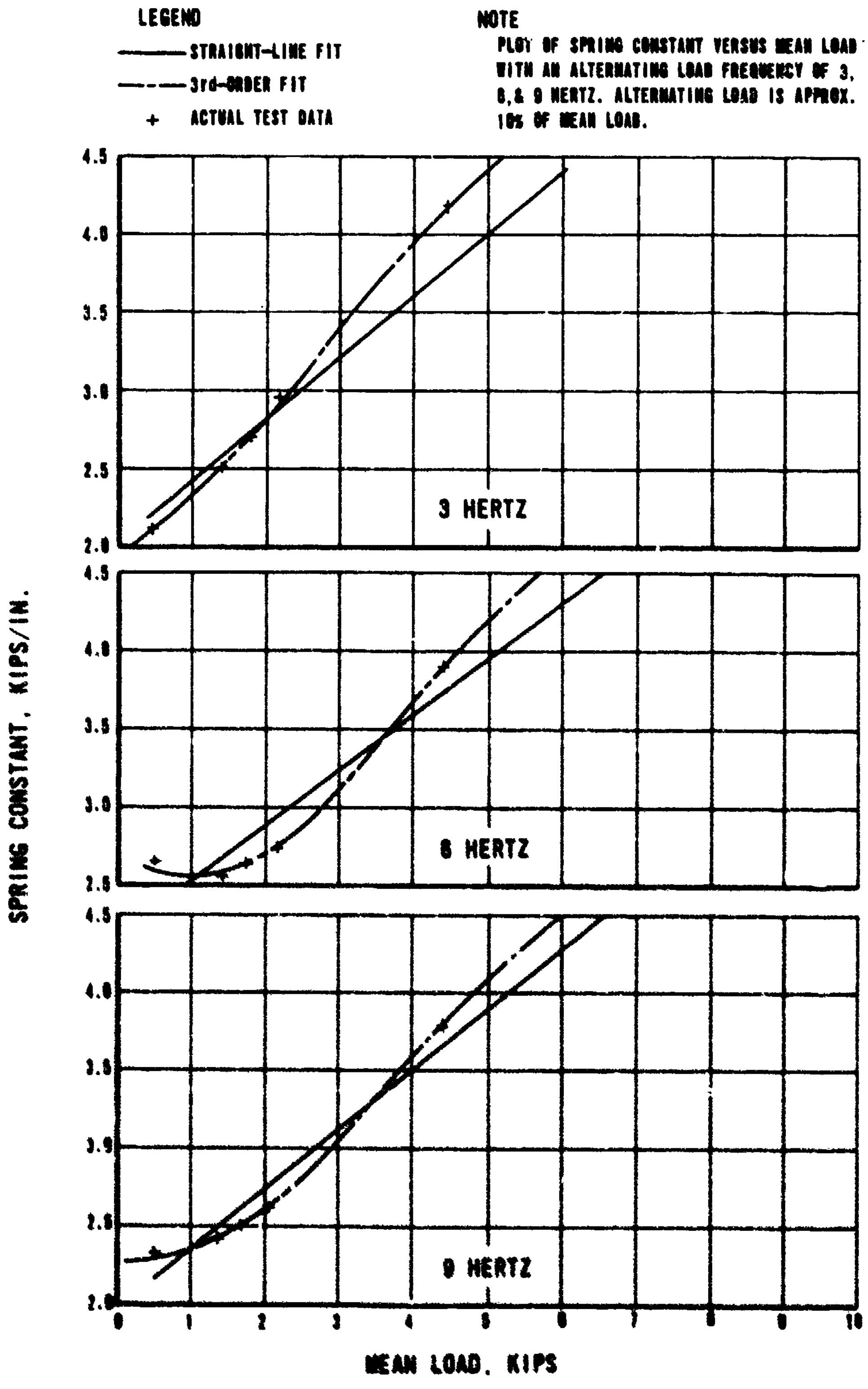

Figure 11. Plot of Viscoelastic Data, Type V Dacron Webbing.

Test	Sample Size	Ultimate Strength Mean (kips)	Standard Deviation (kips)	Does Test Affect Strength?
TABLE VI. STATISTICAL SUMMARY OF TEST RESULTS				
TYPE X - Nylon				
Ultimate Strength Before Exposure	15	10.8	.195	Baseline
Post Outdoor Exposure (16 weeks)	7	9.71	.157	Yes
Post Outdoor Exposure (32 weeks)	5	9.82	.148	Yes
Post Temperature/Humidity	10	10.38	.072	Slightly
Post Seawater Immersion	4	9.38	.165	Yes
Post JP-4 Fuel Immersion	5	10.5	.20	Slightly
Post End Condition (Mean load 8.5K)	2	9.5	0	Yes
Post End Condition (Mean load 13.6K)	3	7.2	.721	Yes
Post End Condition (Mean load 2.5K)	2	9.8	.071	Slightly
Post Indoor Storage (1 year)	5	10.34	.055	Slightly
TYPE XIX - Nylon				
Ultimate Strength Before Exposure	15	11.95	.177	Baseline
Post Outdoor Exposure (16 weeks)	5	10.5	.469	Yes
Post Outdoor Exposure (32 weeks)	4	9.65	.52	Yes
Post Outdoor Exposure (40 weeks)	3	8.9	.7	Yes

TABLE VI - Continued				
Test	Sample Size	Ultimate Strength Mean (kips)	Standard Deviation (kips)	Does Test Affect Strength?
Post Temperature/Humidity	10	12.07	.172	No
Post Seawater Immersion	5	10.98	.192	Slightly
Post JP-4 Fuel Immersion	5	12.64	.114	No
Post End Condition (Mean load 2.77K)	4	11.28	.096	Slightly
Post End Condition (Mean load 9.25K)	4	11.05	.345	Yes
Post End Condition (Mean load 14.8K)	3	8.2	.113	Yes
Post Indoor Storage (1 year)	5	11.26	.503	No
<u>TYPE XXIV - Nylon (Resin)</u>				
Ultimate Strength Before Exposure	15	17.26	.203	Baseline
Post Outdoor Exposure (24 weeks)	5	16.02	.13	Yes
Post Outdoor Exposure (32 weeks)	6	15.03	.683	Yes
Post Temperature/Humidity	9	17.18	.164	No
Post Seawater Immersion	5	16.03	.12	Slightly
Post JP-4 Fuel Immersion	5	16.68	.486	No
Post End Condition (Mean load 4.08K)	4	16.88	.096	Yes
Post End Condition (Mean load 13.6K)	4	16.10	.497	Yes
Post End Condition (Mean load 21.75K)	2	12.10	.707	Yes
Post Outdoor Storage (1 year)	5	16.58	.356	Slightly

TABLE VI - Continued				
Test	Sample Size	Ultimate Strength Mean (kips)	Standard Deviation (kips)	Does Test Affect Strength?
TYPE XXVI - Nylon (Latex)				
Ultimate Strength Before Exposure	28	16.85	.403	Baseline
Post Outdoor Exposure (32 weeks)	5	9.37	.368	Yes
Post Outdoor Exposure (48 weeks)	3	9.8	.265	Yes
Post Outdoor Exposure (64 weeks)	4	10.65	.379	Yes
Post Temperature/Humidity	7	16.39	.756	No
Post Seawater Immersion	5	16.82	.227	Slightly
Post JP-4 Fuel Immersion	5	17.24	.134	No
Post End Condition (Mean load 3.75K)	4	16.27	.479	Slightly
Post End Condition (Mean load 12.5K)	4	15.63	.263	Yes
Post End Condition (Mean load 20K)	4	11.75	.284	Yes
Post Indoor Storage (1 year)	5	16.79	.346	Slightly
TYPE VI - Dacron				
Ultimate Strength Before Exposure	15	20.21	.713	Baseline
Post Outdoor Exposure (16 weeks)	5	18.64	.705	Yes
Post Outdoor Exposure (32 weeks)	4	17.63	.25	Yes
Post Outdoor Exposure (40 weeks)	3	17.17	.764	Yes
Post Temperature/Humidity	10	19.54	.664	No
Post Seawater Immersion	5	19.54	1.58	No

TABLE VI - Continued				
Test	Sample Size	Ultimate Strength Mean (kips)	Standard Deviation (kips)	Does Test Affect Strength?
Post JP-4 Fuel Immersion	4	20.25	.708	No
Post End Condition (Mean load 4.38K)	4	21.10	.337	No
Post End Condition (Mean load 14.5K	4	20.16	.373	No
Post End Condition (Mean load 23.4K)	2	17.42	.247	Yes
Post Indoor Storage (1 year)	5	19.02	.792	No
<u>TYPE V - Dacron</u>				
Ultimate Strength Before Exposure	16	12.3	.577	Baseline
Post Outdoor Exposure (16 weeks)	2	10.95	.212	Yes
Post Outdoor Exposure (32 weeks)	3	10.03	.153	Yes
Post Outdoor Exposure (40 weeks)	2	9.6	.141	Yes
Post Temperature/Humidity	10	12.5	.116	No
Post Seawater Immersion	4	12.8	.149	Yes
Post JP-4 Fuel Immersion	5	12.58	.148	Yes
Post End Condition (Mean load 3.7K)	4	11.9	.096	No
Post End Condition (Mean load 9.0K)	4	11.52	.15	Slightly
Post End Condition (Mean load 14.4K)	2	8.3	.566	Yes
Post Indoor Storage (1 year)	5	12.38	.217	No

TABLE VII. ULTIMATE STRENGTH, TYPE X NYLON WEBBING		
Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
4-19-86	10.70	7.35
4-18-47	10.50	7.45
4-23-70	10.50	7.45
4-29-24	11.10	7.58
4-32-85	11.00	7.35
4-11-17	11.70	7.00
4-30-79	11.00	7.45
4-3-26	10.70	7.38
4-4-76	10.80	7.12
4-20-42	10.80	7.25
4-15-1	10.80	7.39
4-2-41	11.00	7.35
4-6-5	11.00	7.29
4-13-59	11.00	7.12
4-14-92	10.90	7.49
	Mean 10.800	Mean 7.335
	Std Dev 0.195	Std Dev 0.157

TABLE VIII. END-CONDITION EFFECT, TYPE X NYLON WEBBING LOOPED OVER A 1-INCH SHACKLE

Specimen No.	Mean Load (kips)	Alternating Load (kips)	No. of Cycles	Ultimate Load* (kips)
4-24-8	Ultimate	0	0	16.70
4-12-44	Ultimate	0	0	17.30
				Mean 17.000
				Std Dev 0.424
				**
4-10-30	13.6	0.7	10,000	8.00
4-33-18	13.6	0.7	10,000	6.60
4-21-21	13.6	0.7	10,000	7.00
				Mean 7.200
				Std Dev 0.721
4-28-37	2.55	0.7	10,000	9.80
4-31-102	2.55	0.7	10,000	9.90
				Mean 9.850
				Std Dev 0.071
4-9-39	8.50	0.7	10,000	9.60
4-7-31	8.50	0.7	10,000	9.60
				Mean 9.60
				Std Dev 0.00

* Tensile tested looped over 1-inch shackle.
** Tensile tested on single strap after fatigued.

TABLE IX. OUTDOOR EXPOSURE, TYPE X NYLON WEBBING

Specimen No.	Exposure Time (wk)	Ultimate Load (kips)	Ultimate Elongation (in.)
10-74	16	9.70	6.25
10-97	16	9.80	6.41
10-51	16	9.70	6.45
10-52	16	9.40	6.00
10-53	16	9.70	6.25
10-23	16	9.80	6.3[illegible]
10-87	16	9.90	6.53
		Mean 9.914	Mean 6.324
		Std Dev 0.157	Std Dev 0.175
10-95	24	9.80	6.10
10-67	24	10.00	6.22
10-40	24	9.60	5.85
10-25	24	9.80	5.90
10-46	24	9.90	6.22
		Mean 9.820	Mean 6.058
		Std Dev 0.148	Std Dev 0.175

TABLE X. TEMPERATURE/HUMIDITY CYCLING, TYPE X NYLON WEBBING

Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
4-A-7	10.40	5.98
4-B-27	10.40	6.05
4-C-43	10.42	6.70
4-D-8[illegible]	10.40	6.60
4-E-32	10.40	6.72
4-F-14	10.41	6.68
4-G-75	10.40	6.70
4-[illegible]-6	10.42	6.87
4-I-65	10.18	6.82
4-J-63	10.40	6.80
	Mean 10.383	Mean 6.592
	Std Dev 0.072	Std Dev 0.314

TABLE XI. JP-4 FUEL IMMERSION, TYPE X NYLON WEBBING		
Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
4-45-13	10.70	6.55
4-80-99	10.20	6.22
4-94-50	10.60	6.15
4-75-12	10.40	6.45
4-20-112	10.60	6.15
	Mean 10.500	Mean 6.304
	Std Dev 0.200	Std Dev 0.185

TABLE XII. SEAWATER IMMERSION, TYPE X NYLON WEBBING		
Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
4-23-118	9.45	5.99
4-46-19	9.40	6.12
4-87-98	9.35	6.33
4-125-88	9.30	6.33
	Mean 9.375	Mean 6.192
	Std Dev 0.064	Std Dev 0.167

TABLE XIII. SAND ABRASION, TYPE X NYLON WEBBING				
Specimen No.	Sand Size	Mean Load (kips)	Alternating Load (kips)	Cycles to Failure
4-26-16	No Sand	5.4	2.7	1,661
4-17-96	"	5.4	2.7	3,585
4-8-15	"	5.4	2.7	2,478
4-5-61	"	5.4	2.7	2,014
4-27-77	"	5.4	2.7	3,812
				Mean 2,710
				Std Dev 951
4-1-60	Medium	5.4	2.7	10
4-56-124	Medium	5.4	2.7	8
4-54-50	Medium	5.4	2.7	4
4-41-108	Medium	5.4	2.7	6
4-52-117	Medium	5.4	2.7	8
				Mean 7.200
				Std Dev 2.280

TABLE XIV. VISCOELASTIC TEST, TYPE X NYLON WEBBING, GAGE LENGTH 1.125 INCHES

Load (kips)	CPS (Hz)	Gage Length (in.)	Mean Load (kips)	Alternating Load (kips)	Elongation (in.)	Strain 10^{-3}	Spring Constant (lb/in./in.)
1.31	3	1.197	1.29	0.28	0.0023	1.92	145,830
1.31	6	1.197	1.13	0.28	0.0023	1.92	145,830
1.31	9	1.197	1.05	0.28	0.0023	1.92	145,830
1.75	3	1.214	1.69	0.32	0.0025	2.06	155,340
1.75	6	1.214	1.49	0.36	0.0025	2.06	174,760
1.75	9	1.214	1.45	0.32	0.0025	2.06	155,340
2.19	3	1.225	2.23	0.44	0.0028	2.28	192,980
2.19	6	1.225	2.03	0.44	0.0030	2.45	175,920
2.19	9	1.225	1.99	0.46	0.0028	2.28	201,750
4.37	3	1.265	4.21	0.86	0.0038	3.00	286,660
4.37	6	1.265	4.09	0.88	0.0040	3.16	278,480
4.37	9	1.265	4.09	0.88	0.0038	3.00	293,330
6.55	3	1.303	6.35	1.32	0.0050	3.84	343,750
6.55	6	1.303	6.51	1.28	0.0053	4.07	314,500
6.55	9	1.303	6.55	1.24	0.0045	3.45	359,420

TABLE XV. ULTIMATE STRENGTH, TYPE XIX NYLON WEBBING

Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
1-95-47	12.10	6.12
1-113-26	12.10	6.00
1-108-49	12.00	6.28
1-56-42	11.70	5.52
1-59-70	12.00	6.40
1-92-85	12.00	6.46
1-49-62	12.00	6.62
1-122-1	12.00	6.32
1-17-76	12.00	6.62
1-62-24	12.00	6.42
1-1-17	11.90	5.87
1-15-41	12.00	6.40
1-13-110	12.00	6.55
1-10-86	12.00	6.62
1-33-79	11.40	4.88
	Mean 11.947	Mean 6.208
	Std Dev 0.177	Std Dev 0.482

TABLE XVI. END-CONDITION EFFECT, TYPE XIX NYLON WEBBING LOOPED OVER A 1-INCH SHACKLE

Specimen No.	Mean Load (kips)	Alternating Load (kips)	No. of Cycles	Ultimate Load* (kips)
1-99-34	Ultimate	0	0	18.50
1-31-39	Ultimate	0	0	16.75
1-18-68	Ultimate	0	0	18.20
1-111-37	Ultimate	0	0	17.75
1-69-91	Ultimate	0	0	19.20
1-7-8	Ultimate	0	0	20.00
1-75-90	Ultimate	0	0	17.20
1-34-30	Ultimate	0	0	19.50
				Mean 18.387
				Std Dev 1.137
				**
1-14-119	14.8	0.7	10,000	7.50
1-23-89	14.8	0.7	10,000	9.50
1-94-18	14.8	0.7	10,000	7.60
				Mean 8.200
				Std Dev 1.127
1-8-36	9.25	0.7	10,000	11.20
1-38-31	9.25	0.7	10,000	11.00
1-116-120	9.25	0.7	10,000	11.40
1-131-F	9.25	0.7	10 000	10.60
				Mean 11.050
				Std Dev 0.342

TABLE XVI - Continued

Specimen No.	Mean Load (kips)	Alternating Load (kips)	No. of Cycles	Ultimate Load* (kips)
1-129-D	2.78	0.7	10,000	11.30
1-128-C	2.78	0.7	10,000	11.40
1-130-E	2.78	0.7	10,000	11.20
1-126-A	2.78	0.7	10,000	11.20
				Mean 11.275
				Std Dev 0.096

* Tensile tested looped over 1-inch shackle.
** Tensile tested on single strap after fatigued.

TABLE XVII. OUTDOOR EXPOSURE, TYPE XIX NYLON WEBBING

Specimen No.	Exposure Time (wk)	Ultimate Load (kips)	Ultimate Elongation (in.)
1-77-51	16	10.80	4.42
1-96-97	16	10.35	4.09
1-45-95	16	10.70	3.82
1-104-87	16	9.70	3.95
1-103-52	16	10.80	4.55
		Mean 10.470	Mean 4.166
		Std Dev 0.468	Std Dev 0.310
1-74-46	32	10.10	3.62
1-118-40	32	8.90	3.45
1-97-67	32	9.80	3.65
1-121-74	32	9.80	3.65
		Mean 9.650	Mean 3.592
		Std Dev 0.519	Std Dev 0.096
1-44-53	40	9.70	3.85
1-12-25	40	8.60	3.70
1-123-23	40	8.40	3.48
		Mean 8.900	Mean 3.677
		Std Dev 0.700	Std Dev 0.186

TABLE XVIII. TEMPERATURE/HUMIDITY CYCLING, TYPE XIX NYLON WEBBING				
Specimen No.		Ultimate Load (kips)		Ultimate Elongation (in.)
1-114-3		12.15		5.95
1-101-14		12.10		6.18
1-106-65		12.17		6.48
1-50-81		12.15		6.78
1-40-43		12.03		6.74
1-53-75		12.15		6.78
1-46-6		12.18		7.00
1-66-27		12.05		6.82
1-80-32		11.60		5.80
1-71-7		12.10		6.57
	Mean	12.068	Mean	6.482
	Std Dev	0.172	Std Dev	0.392

TABLE XIX. JP-4 FUEL IMMERSION, TYPE XIX NYLON WEBBING				
Specimen No.		Ultimate Load (kips)		Ultimate Elongation (in.)
1-112-99		12.45		5.43
1-39-112		12.70		5.95
1-12-20		12.65		5.50
1-57-13		12.75		6.23
1-120-50		12.65		5.80
	Mean	12.648	Mean	5.782
	Std Dev	0.114	Std Dev	0.329

TABLE XX. SEAWATER IMMERSION, TYPE XIX NYLON WEBBING				
Specimen No.		Ultimate Load (kips)		Ultimate Elongation (in.)
1-89-88		11.05		5.32
1-124-29		11.10		5.78
1-105-118		11.12		5.82
1-36-98		10.65		5.15
1-70-19		11.00		5.65
	Mean	10.984	Mean	5.344
	Std Dev	0.192	Std Dev	0.295

TABLE XXI. SAND ABRASION, TYPE XIX NYLON WEBBING				
Specimen No.	Sand Size	Mean Load (kips)	Alternating Load (kips)	Cycles to Failure
1-83-61	No Sand	6.0	3.0	500
1-68-77	"	6.0	3.0	537
1-11-96	"	6.0	2.8	3,492
1-119-64	"	6.0	2.8	18,832
1-70-16	"	6.0	2.8	5,692
1-28-66	"	6.0	2.8	2,526
1-4-56	"	6.0	2.8	3,287
1-30-122	"	6.0	2.8	1,758
1-19-113	"	6.0	2.8	1,391
1-48-115	"	6.0	2.8	1,910
1-5-116	"	6.0	2.8	1,757
				Mean 3,789
				Std Dev 5,203
1-52-121	½ gram fine	6.0	2.8	9
1-61-20	"	6.0	2.8	22
1-87-9	"	6.0	2.8	10
1-90-111	"	6.0	2.8	24
1-98-114	"	6.0	2.8	27
1-72-123	"	6.0	2.8	23
				Mean 19.200
				Std Dev 7.079

TABLE XXI - Continued				
Specimen No.	Sand Size	Mean Load (kips)	Alternating Load (kips)	Cycles to Failure
1-85-107	½ gram med	6.0	2.8	14
1-117-101	"	6.0	2.8	8
1-102-57	"	6.0	2.8	19
1-82-117	"	6.0	2.8	6
1-58-54	"	6.0	2.8	19
				Mean 13.200
				Std Dev 6.058
1-25-22	½ gram coarse	6.0	2.8	10
1-67-58	"	6.0	2.8	4
1-55-125	"	6.0	2.8	19
1-78-124	"	6.0	2.8	17
1-35-45	"	6.0	2.8	9
				Mean 11.800
				Std Dev 6.100

TABLE XXII. VISCOELASTIC TEST, TYPE XIX NYLON WEBBING, GAGE LENGTH 1.159 INCHES

Load (kips)	CPS (Hz)	Gage Length (in.)	Mean Load (kips)	Alternating Load (kips)	Elongation (in.)	Strain 10^{-3}	Spring Constant (lb/in./in.)
0.49	3	1.176	0.65	0.10	0.0010	0.85	117,650
0.49	6	1.176	0.44	0.10	0.0010	0.85	117,650
0.49	9	1.176	0.35	0.12	0.0012	1.02	117,650
1.46	3	1.237	1.38	0.32	0.0026	2.10	152,380
1.46	6	1.237	1.12	0.30	0.0026	2.10	142,860
1.46	9	1.237	1.16	0.30	0.0025	2.02	148,510
1.95	3	1.253	2.01	0.38	0.0027	2.15	174,740
1.95	6	1.253	1.83	0.40	0.0029	2.31	173,160
1.95	9	1.253	1.75	0.40	0.0030	2.39	167,360
2.44	3	1.270	2.44	0.48	0.0030	2.36	203,390
2.44	6	1,270	2.24	0.51	0.0035	2.75	185,450
2.44	9	1.270	2.22	0.51	0.0035	2.75	185.450
4.87	3	1.316	4.93	0.92	0.0037	2.82	326,240
4.87	6	1.316	4.91	0.96	0.0041	3.12	307,690
4.87	9	1.316	4.93	1.00	0.0042	3.20	312,500
7.30	3	1.342	7.36	[illegible]	0.0045	3.35	405,970
7.30	6	1.342	7.38	1.44	0.0049	3.65	394,520
7.30	9	1.342	7.36	1.32	0.0046	3.43	384,840

TABLE XXIII. ULTIMATE STRENGTH, TYPE XXVI NYLON WEBBING, RESIN COATED

Specimen No.		Ultimate Load (kips)		Ultimate Elongation (in.)
5-37-47		17.10		6.51
5-51-76		17.05		6.41
5-84-85		17.10		6.49
5-39-110		17.10		6.34
5-44-70		17.10		6.49
5-69-86		17.05		6.09
5-13-17		17.40		6.35
5-82-41		17.40		5.43
5-9-79		17.45		6.61
5-81-1		17.10		6.35
5-52-57		17.35		6.36
5-28-82		17.60		6.48
5-15-2		17.60		6.60
5-7-107		17.40		6.72
5-78-62		17.10		6.44
	Mean	17.260	Mean	6.378
	Std Dev	0.20	Std Dev	0.300

TABLE XXIV. END-CONDITION EFFECT, TYPE XXVI NYLON WEBBING, RESIN COATED, LOOPED OVER A 1-INCH SHACKLE

Specimen No.	Mean Load (kips)	Alternating Load (kips)	No. of Cycles	Ultimate Load* (kips)
5-5-8	Ultimate	0	0	28.00
5-27-18	Ultimate	0	0	26.00
5-4-44	Ultimate	0	0	26.50
5-10-102	Ultimate	0	0	26.50
				Mean 26.75
				Std Dev 0.866
				**
5-95-34	4.08	0.7	10,000	17.00
5-83-66	4.08	0.7	10,000	16.80
5-112-31	4.08	0.7	10,000	16.80
5-110-54	4.08	0.7	10,000	16.90
				Mean 16.875
				Std Dev 0.096
5-58-120	13.60	0.7	10,000	16.60
5-105-9	13.60	0.7	10,000	16.40
5-91-89	13.60	0.7	10,000	15.90
5-109-28	13.60	0.7	10,000	15.50
				Mean 16.100
				Std Dev 0.497

TABLE XXIV - Continued

Specimen No.	Mean Load (kips)	Alternating Load (kips)	No. of Cycles	Ultimate Load* (kips)
5-76-30	21.75	0.7	10,000	12.60
5-29-36	21.75	0.7	10,000	11.60
				Mean 12.100
				Std Dev 0.707

* Tensile tested looped over 1-inch shackle.
** Tensile tested on single strap after fatigued.

TABLE XXV. OUTDOOR EXPOSURE,
TYPE XXVI NYLON WEBBING, RESIN COATED

Specimen No.	Exposure Time (wk)	Ultimate Load (kips)	Ultimate Elongation (in.)
5-21-51	26	16.00	5.40
5-57-87	26	15.90	6.50
5-45-74	26	16.20	5.78
5-24-46	26	16.10	5.60
5-48-40	26	15.90	5.10
		Mean 16.020	Mean 5.676
		Std Dev 0.130	Std Dev 0.525
5-6-25	33	14.4	4.95
5-79-103	33	14.0	5.00
5-59-22	33	15.7	4.99
5-12-53	33	15.6	5.36
5-63-64	33	15.3	5.20
		Mean 15.033	Mean 5.100
		Std Dev 0.683	Std Dev 0.175

TABLE XXVI. TEMPERATURE/HUMIDITY CYCLING, TYPE XXVI NYLON WEBBING, RESIN COATED

Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
5-68-121	17.20	7.12
5-60-27	17.10	6.95
5-50-104	17.10	6.65
5-16-84	17.30	7.12
5-65-6	17.20	6.93
5-31-117	16.80	6.62
5-66-43	17.30	6.91
5-53-91	17.30	6.78
5-1-65	17.30	7.00
	Mean 17.178	Mean 6.898
	Std Dev 0.164	Std Dev 0.182

TABLE XXVII. JP-4 FUEL IMMERSION, TYPE XXVI NYLON WEBBING, RESIN COATED

Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
5-62-112	16.50	5.85
5-30-56	17.20	6.52
5-36-109	17.20	6.12
5-17-125	16.25	5.91
5-35-12	16.25	6.05
	Mean 16.680	Mean 6.090
	Std Dev 0.486	Std Dev 0.263

TABLE XXVIII. SEAWATER IMMERSION, TYPE XXVI NYLON WEBBING, RESIN COATED

Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
5-42-98	16.10	5.62
5-3-29	16.15	5.76
5-8-94	16.10	5.85
5-23-83	15.90	5.88
5-73-118	15.90	5.82
	Mean 16.030	Mean 5.786
	Std Dev 0.120	Std Dev 0.103

TABLE XXIX. SAND ABRASION, TYPE XXVI NYLON WEBBING, RESIN COATED

Specimen No.	Sand Size	Mean Load (kips)	Alternating Load (kips)	Cycles to Failure
5-18-114	No Sand	8.00	4.00	2,848
5-64-10	"	8.00	4.00	3,442
5-23-11	"	8.00	4.00	1,902
5-20-80	"	8.00	4.00	545
5-22-4	"	8.00	4.00	1,958
				Mean 2,139
				Std Dev 1,099
5-61-10	Medium	8.00	4.00	9
5-72-100	"	8.00	4.00	7
5-75-11	"	8.00	4.00	5
5-70-38	"	8.00	4.00	4
5-22-55	"	8.00	4.00	1
				Mean 5.200
				Std Dev 3.033

TABLE XXX. VISCOELASTIC TEST,
TYPE XXVI NYLON WEBBING, RESIN COATED,
GAGE LENGTH 1.187 INCHES

Load (kips)	CPS (Hz)	Gage Length (in.)	Mean Load (kips)	Alternating Load (kips)	Elongation (in.)	Strain 10^{-3}	Spring Constant (lb/in./in.)
0.66	3	1.237	0.76	0.06	0.00181	1.46	41,100
0.66	6	1.237	0.66	0.06	0.00161	1.33	45,112
0.66	9	1.237	0.62	0.07	0.00161	1.33	52,631
2.00	3	1.292	1.97	0.19	0.00321	2.51	75,697
2.00	6	1.292	1.90	0.21	0.00351	2.70	77,777
2.00	9	1.292	1.88	0.20	0.00351	2.51	79,882
2.66	3	1.315	2.64	0.24	0.00351	2.66	90,227
2.66	6	1.315	2.57	0.26	0.00351	2.66	97,745
2.66	9	1.315	2.54	0.28	0.00371	2.80	100,000
3.32	3	1.331	3.29	0.32	0.00411	3.09	103,560
3.32	6	1.331	3.23	0.34	0.00421	3.19	106,583
3.32	9	1.331	3.22	0.34	0.00421	3.19	106,583
6.65	3	1.381	6.60	0.64	0.00511	3.70	172,972
6.65	6	1.381	6.56	0.64	0.00561	4.06	157,635
6.65	9	1.381	6.52	0.64	0.00541	3.89	164,524
10.00	3	1.409	9.95	0.96	0.00661	4.69	204,690
10.00	6	1.409	9.89	0.96	0.00641	4.52	212,389
10.00	9	1.409	9.86	0.94	0.00641	4.52	207,964

TABLE XXXI. ULTIMATE STRENGTH,
TYPE XXVI NYLON WEBBING, LATEX COATED

Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
114-1	17.10	5.69
115-1	16.70	-
70-1	16.70	5.84
121-1	16.90	5.40
79-1	16.60	5.40
47-1	17.25	5.20
34-1	16.70	5.50
122-1	16.50	5.46
49-1	17.30	5.92
62-1	16.20	5.05
76-1	17.30	5.65
24-1	16.60	5.55
85-1	17.10	5.55
107-1	16.60	5.10
104-1	16.80	5.15
113-1	16.90	5.05
58-1	17.05	5.35
66-1	17.40	5.30
93-1	16.80	5.20
84-1	17.20	5.38
28-1	17.60	5.70

TABLE XXXI - Continued		
Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
109-1	16.55	5.50
64-1	17.10	5.50
116-1	16.2	5.10
17-1	16.0	5.55
103-1	16.5	5.05
83-1	17.5	5.95
82-1	16.7	5.40
	Mean 16.852	Mean 5.426
	Std Dev 0.403	Std Dev 0.262

TABLE XXXII. END-CONDITION EFFECT, TYPE XXVI NYLON WEBBING, LATEX COATED, LOOPED OVER A 1-INCH SHACKLE

Specimen No.	Mean Load (kips)	Alternating Load (kips)	No. of Cycles	Ultimate Load* (kips)
5-25	3.75	0.7	10,000	16.7
5-26	3.75	0.7	10,000	15.6
5-15	3.75	0.7	10,000	16.3
5-22	3.75	0.7	10,000	13.3
				Mean 16.275
				Std Dev 0.479
5.13	12.50	0.7	10,000	16.0
5-11	12.50	0.7	10,000	15.4
5-12	12.50	0.7	10,000	15.6
5-14	12.50	0.7	10,000	15.5
				Mean 1[illegible].625
				Std Dev 0.263
5-20	20.00	0.7	10,000	8.6
5-8	20.00	0.7	10,000	10.1
5-7	20.00	0.7	10,000	14.4
5-9	20.00	0.7	10,000	13.9
				Mean 11.750
				Std Dev 2.845

* Tensile tested on single strap after fatigued.

TABLE XXXIII. OUTDOOR EXPOSURE,
TYPE XXVI NYLON WEBBING, LATEX COATED

Specimen No.	Exposure Time (wk)	Ultimate Load (kips)	Ultimate Elongation (in.)
25-9	32	9.70	7.16
46-9	32	9.66	7.78
23-9	32	8.80	7.35
53-9	32	9.60	7.46
74-9	32	9.53	7.30
		Mean 9.366	Mean 7.401
		Std Dev 0.368	Std Dev 0.233
52-9	48	10.40	7.65
67-9	48	10.40	7.45
40-9	48	11.20	7.67
95-9	48	10.60	7.55
		Mean 10.650	Mean 7.580
		Std Dev 0.379	Std Dev 0.101
51-9	64	9.70	7.50
87-9	64	10.10	7.52
97-9	64	9.60	7.57
		Mean 9.800	Mean 7.530
		Std Dev 0.265	Std Dev 0.036

TABLE XXXIV. TEMPERATURE/HUMIDITY CYCLING, TYPE XXVI NYLON WEBBING, LATEX COATED

Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
5-2	15.20	5.50
3-2	17.00	7.05
7-2	17.20	6.88
43-2	17.20	7.08
75-2	17.40	7.00
32-2	17.20	7.30
27-2	17.00	6.42
	Mean 16.886	Mean 6.747
	Std Dev 0.756	Std Dev 0.613

TABLE XXXV. JP-4 FUEL IMMERSION, TYPE XXVI NYLON WEBBING, LATEX COATED		
Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
112-4	17.10	6.10
50-4	17.10	6.45
99-4	17.30	6.87
12-4	17.30	6.35
13-4	17.40	6.73
	Mean 17.240	Mean 6.500
	Std Dev 0.124	Std Dev 0.306

TABLE XXXVI. SEAWATER IMMERSION, TYPE XXVI NYLON WEBBING, LATEX COATED		
Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
29-3	15.95	5.65
19-3	16.00	5.80
118-3	15.98	5.78
88-3	15.[illegible]	5.82
98-3	15.65	5.53
	Mean 15.816	Mean 5.716
	Std Dev 0.227	Std Dev 0.123

TABLE XXXVII. SAND ABRASION,
TYPE XXVI NYLON WEBBING, LATEX COATED

Specimen No.	Sand Size	Mean Load (kips)	Alternating Load (kips)	Cycles to Failure
71-7	No Sand	8.0	4.0	694
92-8	"	8.0	4.0	942
55-7	"	8.0	4.0	838
4-7	"	8.0	4.0	2,206
38-7	"	8.0	4.0	517
				Mean 1,039
				Std Dev 671
48-7	½ gram med	8.0	4.0	6
59-8	"	8.0	4.0	3
[illegible]5-8	"	8.0	4.0	8
22-8	"	8.0	4.0	10
60-8	"	8.0	4.0	6
				Mean 6.60
				Std Dev 2.608

TABLE XXXVIII. VISCOELASTIC TEST,
TYPE XXVI NYLON WEBBING, LATEX COATED,
GAGE LENGTH 1.187 INCHES

Load (kips)	CPS (Hz)	Gage Length (in.)	Mean Load (kips)	Alternating Load (kips)	Elongation (in.)	Strain 10^{-3}	Spring Constant (lb/in./in.)
0.66	3	1.220	0.62	0.07	0.0020	1.64	42,682
0.66	6	1.220	0.62	0.08	0.0020	1.64	48,780
0.66	9	1.220	0.62	0.08	0.0020	1.64	48,780
2.00	3	1.270	2.00	0.18	0.0030	2.36	76,271
2.00	6	1.270	1.94	0.20	0.0030	2.36	84,745
2.00	9	1.270	1.92	0.20	0.0030	2.36	84,745
2.66	3	1.292	2.66	0.24	0.0035	2.71	88,560
2.66	6	1.292	2.64	0.26	0.0039	3.00	86,660
2.66	9	1.292	2.61	0.26	0.0038	2.90	99,655
3.32	3	1.304	3.29	0.30	0.0038	2.88	104,166
3.32	6	1.304	3.23	0.33	0.0046	3.53	93,484
3.32	9	1.304	3.22	0.33	0.0041	3.14	105,095
6.65	3	1.342	6.65	0.61	0.0050	3.73	163,539
6.65	6	1.342	6.63	0.62	0.0052	3.87	160,206
6.65	9	1.342	6.59	0.64	0.0047	3.50	182,857
10.00	3	1.381	9.96	0.88	0.0051	3.69	238,482
10.00	6	1.381	9.92	0.96	0.0055	3.98	241,206
10.00	9	1.381	9.92	0.96	0.0052	3.76	255,319

TABLE XXXIX. ULTIMATE STRENGTH, TYPE VI DACRON WEBBING		
Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
3-31-1	18.95	3.45
3-68-86	21.00	
3-39-79	19.75	3.42
3-14-62	20.50	3.58
3-55-41	20.00	3.20
3-111-70	19.50	3.60
3-98-49	20.25	3.48
3-54-110	20.25	3.52
3-42-17	20.00	3.15
3-106-24	20.00	3.35
3-92-76	19.50	3.25
3-12-26	20.50	3.45
3-109-85	22.00	3.52
3-7-47	20.50	3.40
3-34-42	20.00	3.48
	Mean 20.213	Mean 3.418
	Std Dev 0.712	Std Dev 0.136

TABLE XL. END-CONDITION EFFECT, TYPE VI DACRON WEBBING LOOPED OVER A 1-INCH SHACKLE

Specimen No.	Mean Load (kips)	Alternating Load (kips)	No. of Cycles	Ultimate Load* (kips)
3-70-9	Ultimate	0	0	29.50
3-56-31	Ultimate	0	0	29.00
				Mean 29.250
				Std Dev 0.354
				**
3-110-28	23.4	0.7	10,000	17.25
3-51-39	23.4	0.7	10,000	17.60
				Mean 17.425
				Std Dev 0.247
3-65-21	14.5	0.7	10,000	20.25
3-97-120	14.5	0.7	10,000	19.70
3-10-119	14.5	0.7	10,000	20.10
3-18-8	14.5	0.7	10,000	20.60
				Mean 20.162
				Std Dev 0.373
3-117-23	4.38	0.7	10,000	21.50
3-2-36	4.38	0.7	10,000	20.70
3-84-18	4.38	0.7	10,000	21.00
3-11-33	4.38	0.7	10,000	21.20
				Mean 21.100
				Std Dev 0.337

* Tensile tested looped over 1-inch shackle.
** Tensile tested on single strap after fatigued.

TABLE XLI. OUTDOOR EXPOSURE, TYPE VI DACRON WEBBING

Specimen No.	Exposure Time (wk)	Ultimate Load (kips)	Ultimate Elongation (in.)
3-88-52	16	19.50	3.58
3-72-51	16	19.20	3.15
3-6-95	16	17.90	3.15
3-61-87	16	18.20	3.25
3-100-90	16	19.30	3.90
		Mean 18.820	Mean 3.406
		Std Dev 0.719	Std Dev 0.328
3-96-74	32	17.50	3.00
3-101-58	32	17.50	2.95
3-53-67	32	17.50	2.85
3-112-40	32	18.00	3.02
		Mean 17.625	Mean 2.955
		Std Dev 0.250	Std Dev 0.076
3-29-53	40	16.50	2.75
3-87-104	40	17.00	3.12
3-3-25	40	18.00	3.42
		Mean 17.167	Mean 3.097
		Std Dev 0.764	Std Dev 0.336

TABLE XLII. TEMPERATURE/HUMIDITY CYCLING, TYPE VI DACRON WEBBING

Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
3-89-117	20.20	4.26
3-75-7	20.00	4.14
3-114-43	19.50	3.74
3-99-27	19.70	4.06
3-94-3	19.40	3.80
3-103-32	20.00	4.06
3-44-14	19.00	3.80
3-104-65	19.20	3.76
3-16-81	20.30	4.86
3-27-6	18.10	3.66
	Mean 19.540	Mean 4.013
	Std Dev 0.664	Std Dev 0.357

TABLE XLIII. JP-4 FUEL IMMERSION, TYPE VI DACRON WEBBING		
Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
3-49-50	20.80	4.75
3-73-99	20.70	5.00
3-108-13	19.25	4.42
3-64-12	20.23	4.75
	Mean 20.245	Mean 4.730
	Std Dev 0.708	Std Dev 0.238

TABLE XLIV. SEAWATER IMMERSION, TYPE VI DACRON WEBBING		
Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
3-23-19	20.80	3.92
3-43-29	21.10	4.20
3-90-88	18.30	3.50
3-62-118	20.00	3.89
3-91-98	17.50	3.62
	Mean 19.540	Mean 3.826
	Std Dev 1.576	Std Dev 0.274

TABLE XLV. SAND ABRASION, TYPE VI DACRON WEBBING				
Specimen No.	Sand Size	Mean Load (kips)	Alternating Load (kips)	Cycles to Failure
3-116-48	No Sand	10.00	2.60	529
3-38-10	"	10.00	2.30	3,582
3-47-55	"	10.00	2.30	4,400
3-107-71	"	10.00	2.30	3,874
3-17-15	"	10.00	2.30	2,038
3-32-96	"	10.00	2.30	2,096
				Mean 2,753
				Std Dev 1,452
3-28-61	½ gram med	10.00	2.30	2
3-102-114	"	10.00	2.30	1
3-4-77	¼ gram med	10.00	2.30	4
3-58-38	"	10.00	2.30	4
				Mean 2.750
				Std Dev 1.500

TABLE XLVI. VISCOELASTIC TEST, TYPE VI DACRON WEBBING, GAGE LENGTH 1.880 INCHES

Load (kips)	CPS (Hz)	Gage Length (in.)	Mean Load (kips)	Alternating Load (kips)	Elongation (in.)	Strain 10^{-3}	Spring Constant (lb/in./in.)
0.78	3	1.89	0.86	0.07	0.0006	0.32	220,820
0.78	6	1.89	0.78	0.08	0.0006	0.32	252,365
0.78	9	1.89	0.78	0.07	0.0006	0.32	220,820
2.32	3	1.92	2.32	0.24	0.0015	0.78	307,298
2.32	6	1.92	2.12	0.24	0.0014	0.73	329,218
2.32	9	1.92	1.92	0.24	0.0014	0.73	329,218
3.10	3	1.93	3.11	0.29	0.0011	0.83	349,819
3.10	6	1.93	3.06	0.29	0.0015	0.78	373,230
3.10	9	1.93	3.06	0.31	0.0015	0.78	398,970
3.88	3	1.94	3.85	0.38	0.0020	1.03	368,574
3.88	6	1.94	3.81	0.38	0.0018	0.93	409,482
3.88	9	1.94	3.80	0.39	0.0016	0.82	472,727
7.75	3	1.98	7.74	0.74	0.0024	1.21	610,561
7.75	6	1.98	7.64	0.75	0.0028	1.41	530,410
7.73	9	1.98	7.63	0.76	0.0028	1.41	537,482
11.60	3	2.01	11.56	1.12	0.0030	1.49	750,167
11.60	6	2.01	11.50	1.08	0.0030	1.49	723,375
11.60	9	2.01	11.44	1.12	0.0032	1.59	703,517

TABLE XLVII. ULTIMATE STRENGTH, TYPE V DACRON WEBBING		
Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
2-105-86	10.30	2.65
2-46-76	12.50	3.02
2-39-70	12.50	3.38
2-35-47	12.60	2.90
2-92-42	12.40	3.50
2-36-1	12.60	3.15
2-63-62	12.40	3.30
2-94-26	12.40	3.25
2-70-24	12.30	3.22
2-17-85	12.30	3.22
2-36-1	12.60	3.15
2-103-41	12.40	3.10
2-112-17	12.50	3.15
2-89-110	12.50	3.28
2-116-103	11.60	2.97
2-15-79	12.50	3.15
	Mean 12.275	Mean 3.150
	Std Dev 0.577	Std Dev 0.199

TABLE XLVII. END-CONDITION EFFECT, TYPE V DACRON WEBBING, LOOPED OVER A 1-INCH SHACKLE

Specimen No.	Mean Load (kips)	Alternating Load (kips)	No. of Cycles	Ultimate Load* (kips)
2-160-121	Ultimate	0	0	18.60
2-79-122	Ultimate	0	0	17.40
2-83-35	Ultimate	0	0	18.20
				Mean 18.067
				Std Dev 0.611
				**
2-10-119	14.4	0.7	10,000	7.90
2-32-2	14.4	0.7	10,000	8.70
				Mean 8.300
				Std Dev 0.566
2-34-39	9.0	0.7	10,000	11.40
2-69-34	9.0	0.7	10,000	11.60
2-4-28	9.0	0.7	10,000	11.70
2-95-120	9.0	0.7	10,000	11.40
				Mean 11.525
				Std Dev 0.150
2-67-44	2.7	0.7	10,000	12.00
2-8-31	2.7	0.7	10,000	11.90
2-22-18	2.7	0.7	10,000	11.80
2-30-102	2.7	0.7	10,000	12.00
				Mean 11.925
				Std Dev 0.096

* Tensile tested looped over 1-inch shackle.
** Tensile tested on single strap after fatigued.

TABLE XLIX. OUTDOOR EXPOSURE, TYPE V DACRON WEBBING			
Specimen No.	Exposure Time (wk)	Ultimate Load (kips)	Ultimate Elongation (in.)
2-59-97	16	9.20	3.35
2-113-72	16	8.90	2.98
2-71-87	16	9.65	3.33
2-80-52	16	11.10	3.62
2-110-45	16	10.80	3.52
		Mean 9.930	Mean 3.360
		Std Dev 0.974	Std Dev 0.244
2-111-46	32	10.00	2.85
2-104-74	32	9.90	3.22
2-105-125	32	10.20	3.32
		Mean 10.033	Mean 3.130
		Std Dev 0.153	Std Dev 0.248
2-91-53	40	9.70	2.92
2-13-23	40	9.50	3.00
		Mean 9.60	Mean 2.960
		Std Dev 0.141	Std Dev 0.056

TABLE L. TEMPERATURE/HUMIDITY CYCLING, TYPE V DACRON WEBBING		
Specimen No.	Ultimate Load (kips)	Ultimate Elongation (in.)
2-50-27	12.70	3.87
2-44-14	12.60	3.70
2-77-43	12.30	3.87
2-56-32	12.44	3.56
2-76-3	12.50	3.90
2-68-65	12.40	3.90
2-58-81	12.50	3.92
2-23-6	12-50	3.82
2-31-75	12.45	3.82
2-53-7	12.55	3.99
	Mean 12.499	Mean 3.835
	Std Dev 0.116	Std Dev 0.123

TABLE LIII. SAND ABRASION, TYPE V DACRON WEBBING				
Specimen No.	Sand Size	Mean Load (kips)	Alternating Load (kips)	Cycles to Failure
2-107-59	No Sand	6.25	3.12	930
2-55-5	"	6.25	3.12	420
2-9-92	"	6.25	3.12	3,596
2-45-22	"	6.25	3.12	4,407
2-6-60	"	6.25	3.12	134
2-43-38	"	6.25	3.12	905
2-47-55	"	6.25	3.12	3,108
2-3-71	"	6.25	3.12	466
2-73-77	"	6.25	3.12	741
				Mean 1,634
				Std Dev 1,605
2-115-48	½ gram med	6.25	3.12	3
2-101-16	"	6.25	3.12	1
				Mean 2.000
				Std Dev 1.410
2-97-51	¼ gram med	6.25	3.12	2
2-7-15	"	6.25	3.12	3
2-75-96	"	6.25	3.12	3
				Mean 2.669
				Std Dev 0.577

TABLE LIV. VISCOELASTIC TEST, TYPE V DACRON WEBBING, GAGE LENGTH 1.188 INCHES

Load (kips)	CPS (Hz)	Gage Length (in.)	Mean Load (kips)	Alternating Load (kips)	Elongation (in.)	Strain 10^{-3}	Spring Constant (lb/in./in.)
0.45	3	1.193	0.45	0.09	0.0005	0.42	214,800
0.45	6	1.193	0.50	0.09	0.0004	0.34	268,660
0.45	9	1.193	0.50	0.10	0.0005	0.42	238,660
1.35	3	1.210	1.39	0.28	0.0014	1.16	242,000
1.35	6	1.210	1.40	0.22	0.0011	0.91	242,020
1.35	9	1.210	1.37	0.26	0.0014	1.16	224,720
1.80	3	1.221	1.78	0.34	0.0015	1.23	276,870
1.80	6	1.221	1.74	0.40	0.0018	1.47	271,370
1.80	9	1.221	1.67	0.38	0.0018	1.47	257,800
2.25	3	1.232	2.22	0.43	0.0018	1.46	294,320
2.25	6	1.232	2.15	0.43	0.0019	1.54	278,860
2.25	9	1.232	2.03	0.44	0.0020	1.62	271,100
4.50	3	1.266	4.47	0.86	0.0026	2.05	418,700
4.50	6	1.266	4.42	0.86	0.0028	2.21	388,790
4.50	9	1.266	4.37	0.86	0.0029	2.29	375,380
6.75	3	1.288	6.91	1.26	0.0036	2.76	455,860
6.75	6	1.288	6.71	1.50	0.0042	3.30	454,540
6.75	9	1.288	6.87	1.42	0.0041	3.15	450,510

TABLE LV. ULTIMATE STRENGTH AFTER 1-YEAR INDOOR STORAGE

Type Webbing	Specimen No.	Ultimate Elongation (in.)	Ultimate Load (kips)
Dacron Type V	2-2-10	5.4	12.3
Dacron Type V	2-66-80	6.1	12.3
Dacron Type V	2-52-69	6.5	12.1
Dacron Type V	2-29-11	6.6	12.6
Dacron Type V	2-40-100	6.3	12.6
		Mean 6.180	Mean 12.380
		Std Dev 0.476	Std Dev 0.217
Dacron Type VI	3-21-100	6.6	19.5
Dacron Type VI	3-105-82	7.1	20.0
Dacron Type VI	3-57-92	6.0	18.0
Dacron Type VI	3-95-60	7.3	19.1
Dacron Type VI	3-35-11	6.8	18.5
		Mean 6.760	Mean 19.020
		Std Dev 0.503	Std Dev 0.792
Nylon Type X	X-1	11.6	10.4
Nylon Type X	X-2	11.5	10.3
Nylon Type X	X-3	11.0	10.3
Nylon Type X	X-4	11.5	10.4
Nylon Type X	X-5	13.6	10.3
		Mean 11.840	Mean 10.340
		Std Dev 1.011	Std Dev 0.055

TABLE LV - Continued

Type Webbing	Specimen No.	Ultimate Elongation (in.)	Ultimate Load (kips)
Nylon Type XIX	1-115-80	9.7	11.7
Nylon Type XIX	1-42-10	9.3	11.5
Nylon Type XIX	1-88-69	9.0	10.5
Nylon Type XIX	1-26-4	9.4	11.0
Nylon Type XIX	1-84-11	9.3	11.6
		Mean 9.340	Mean 11.260
		Std Dev 0.251	Std Dev 0.503
Nylon Type XXVI-L	44-6	11.6	17.0
Nylon Type XXVI-L	15-5	11.1	17.0
Nylon Type XXVI-L	77-5	11.3	16.8
Nylon Type XXVI-L	16-5	11.0	17.0
Nylon Type XXVI-L	61-5	9.8	16.2
		Mean 10.960	Mean 16.800
		Std Dev 0.688	Std Dev 0.346
Nylon Type XXVI-R	5-14-22	10.6	16.0
Nylon Type XXVI-R	5-11-59	10.8	16.9
Nylon Type XXVI-R	5-34-5	12.0	16.8
Nylon Type XXVI-R	5-32-60	11.6	16.7
Nylon Type XXVI-R	5-113-39	11.2	16.5
		Mean 11.240	Mean 16.580
		Std Dev 0.573	Std Dev 0.356